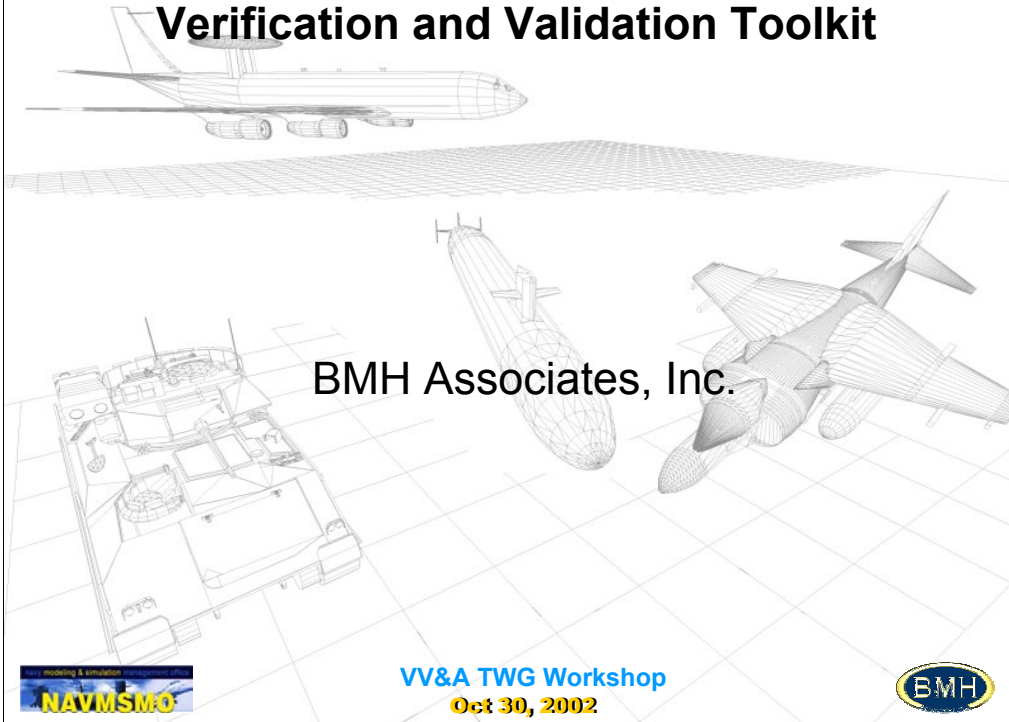


Verification and Validation Toolkit



BMH Associates, Inc.



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Overview

- **Methodology and Terms**
- **Fair Fight Issues**
- **Verification and Validation Toolkit**



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Methodology and Terms

- **Object Requirements Analysis**

- Document to the entity or system level of detail the object requirements for each initiative area and the overall experimental objectives

- Review of various orders of battle (OOB)
 - Breakdown of aggregated units in the OOB to the entity/system level
 - Analysis of sensors, weapons and other objects required in specific experimental threads.



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Methodology and Terms

- Capability Requirements Analysis
 - Review the capability representation for each object in the context of the experiment
 - All capabilities for each object may not be required
- Object and Capability Requirement Documentation
 - Object and capability representation requirements identified



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Methodology and Terms

- Acceptability Criteria Determination
 - Capabilities of each required object are defined based on intended use.
 - Develop a set of "acceptability criteria" for each object-capability pairing that describes the physical and mission behavior capabilities needed to support experiment objectives



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Methodology and Terms

- **Data Validation**

- Model information, representative names, terrain data, and weapons information is compared to experiment requirements and real world objects being represented.
- Compared to predetermined acceptability criteria to confirm the resolution of fidelity required. The results of the data validation were recorded in the Validation database.

- **Intended Use**

- Fundamental to define validation acceptability criteria and to define the scope and limitations of the simulation representation.



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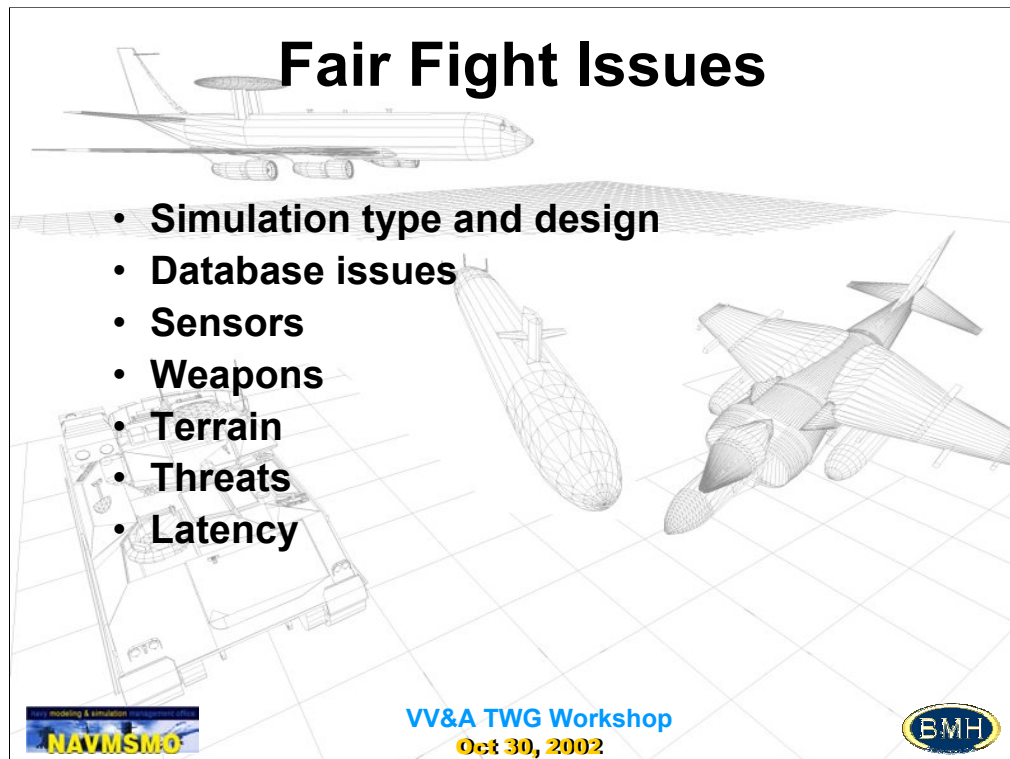
Fair Fight

- **“The accuracy of a representation compared to the real world given intended use”.**
 - DoD & Service VV&A policies and in the updated DMSO VV&A Recommended Practices Guide (RPG)
- **Validation is “the process of determining the degree to which a model is an accurate representation of the real world from the perspective of the intended uses of the model”**



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There are no rules in a knife fight and no one said air combat was anything less than a knife fight – Anonymous

Certainly, the common synthetic environment will cause fair fight issues without similar databases and correlation.

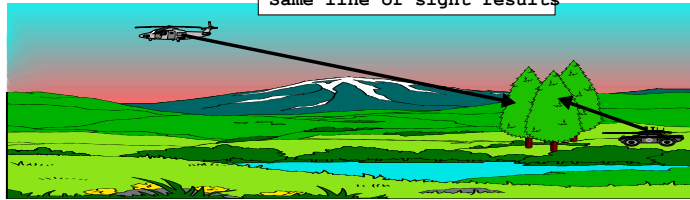
Weapons fidelity and scoring must be an accepted form in order to have credibility. It cannot depend on varying models being introduced from different sites or sources.

Latency is actually a combination of “delays” due to hardware, software, and physics (or geography for the math impaired). The speed of light and associated physics affects latency over a WAN. Basically the greater the distance the more latency that can be introduced

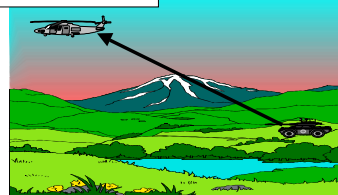
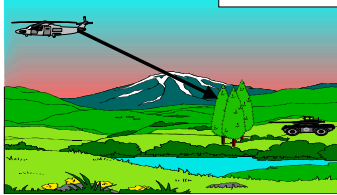
Fair fight assessment must be performed at the physical and mission behavior levels. Fair fight at the physical level is directly observable in real-time, however, fair fight at the mission behavior level is only indirectly observable in real time for CGF through visualization applications and the CGF user interface.

Fair Fight: Line of Sight Example

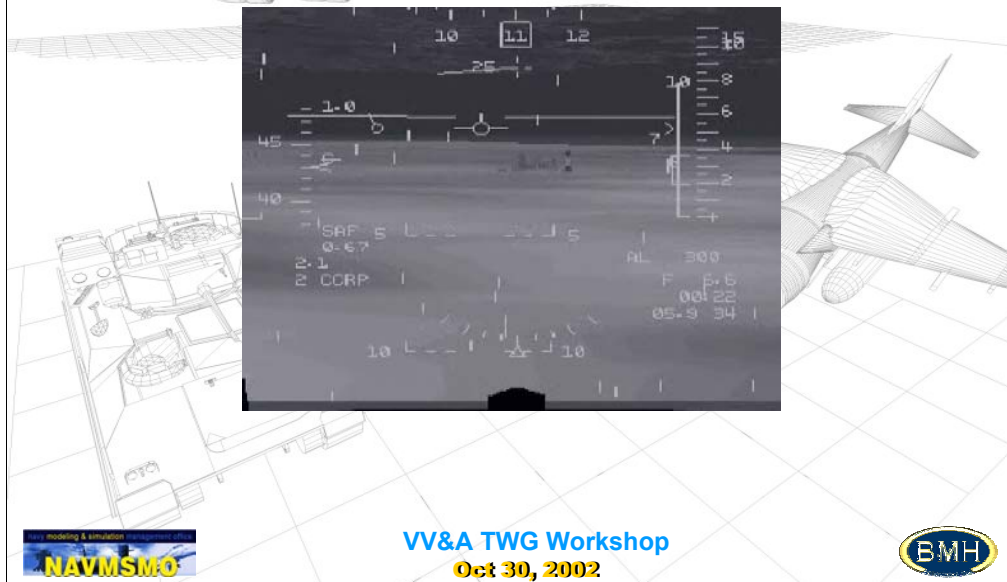
Correlated databases =
Same line of sight results



Uncorrelated databases =
Line of sight differences

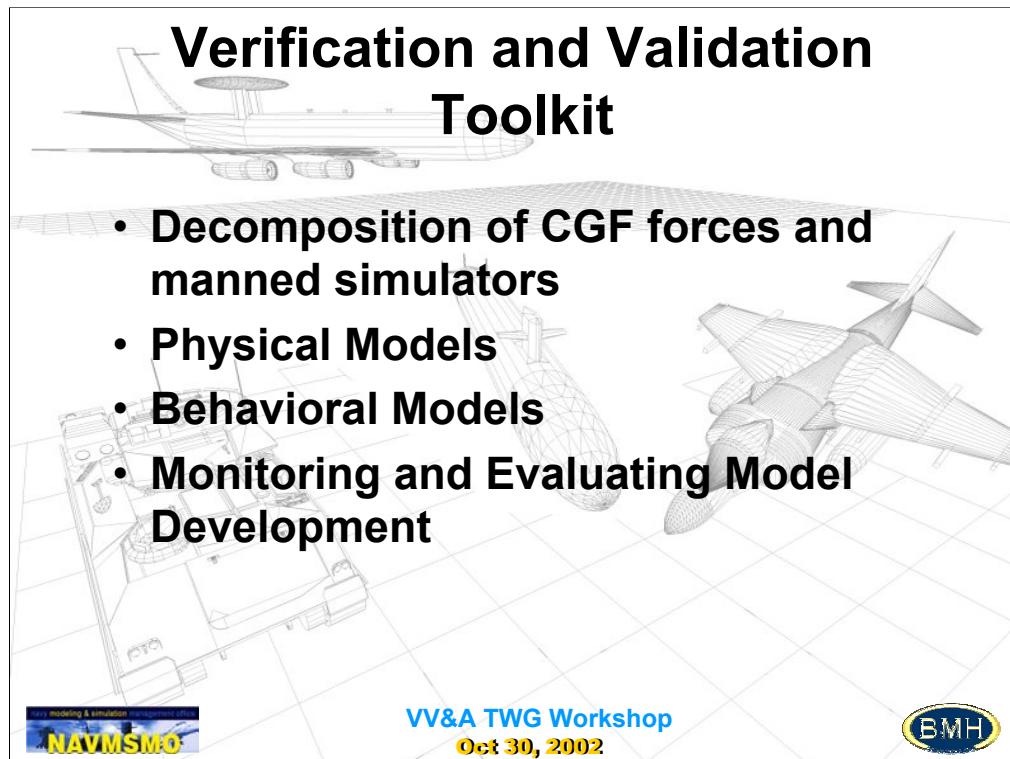


Simulation to Reality



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Verification and Validation Toolkit

- Decomposition of CGF forces and manned simulators
- Physical Models
- Behavioral Models
- Monitoring and Evaluating Model Development



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The CGF interaction validation must consider behaviors, communications and the interfaces among the network participants.

Physical models of the entity (weight, speed, etc.) and how it affects and is affected by the environment. (6 DOF fly out vs. implicit flyout—bullets verses missiles)

A “mission behavior” is defined as “a sequence of decisions, each triggered by an event, that are made to initiate and terminate basic interactions (maneuver, navigation, communication, sensor, emitter, and weapon employment) dependent on the tactics, techniques, and procedures (TTP), standard operating procedures (SOP), rules of engagement (ROE), and the operations order or mission plan currently in effect.” Each decision in the sequence is “triggered” by an event.

The subsequent model evaluations should be a systematic review and analysis for:

Relevance to objectives,

Efficiency in simulation and network operation,

Effectiveness in achieving training audience results,

Impact on overall objectives and

Sustainability over time.

Verification and Validation Toolkit

- Allows developers and subject matter experts to categorize each aspect of simulators, simulations and their interactions in order to ensure fair fight
- Developed using COTS software to provide a central point for traceability, requirements analysis, entity attributes, model behaviors, acceptability criteria, and testing procedures.

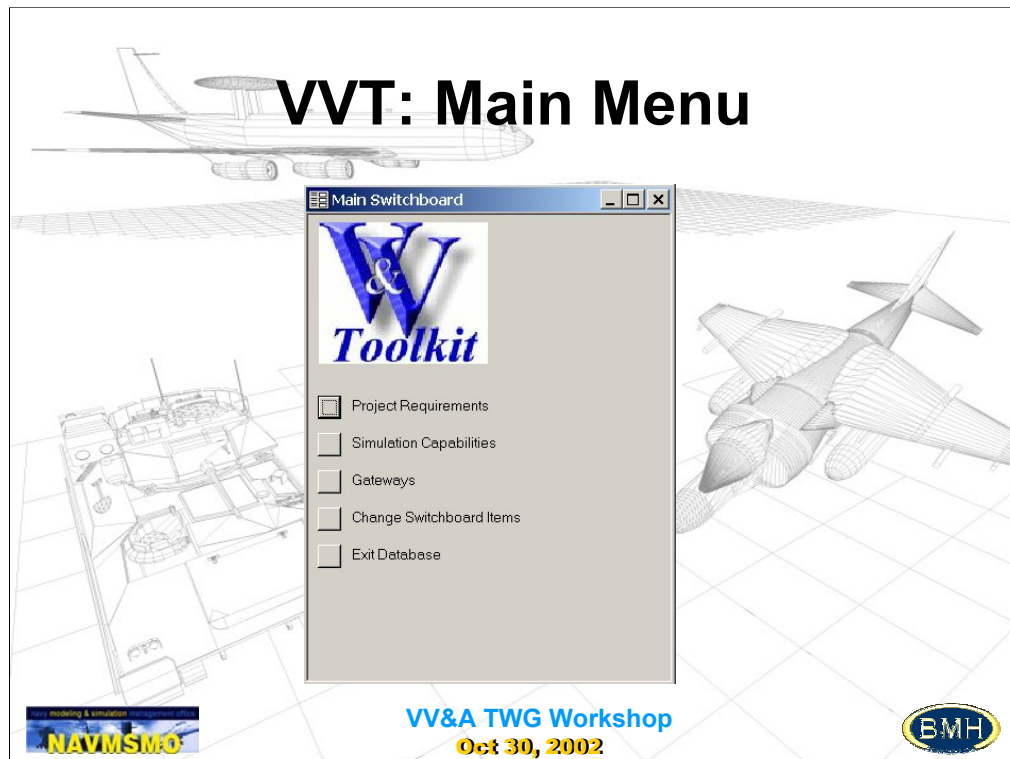


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A robust Verification and Validation (V&V) capability with current tools can be provided to NASMP for quantitative and qualitative evaluations.

Networked (LAN/WAN) multi user system. Update 'replica' users to the 'Master' via the internet



Opening the VV Toolkit presents the Main Switchboard. Options allow the user to navigate to: Project Requirements, Simulation Capabilities, Gateways, Change Switchboard Items, and Exit Database.

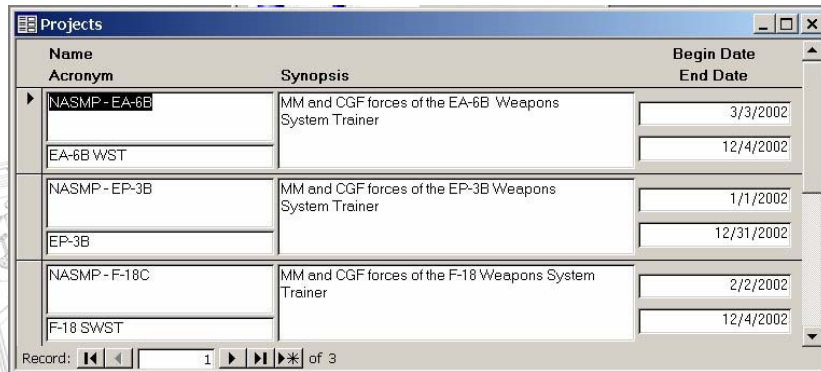
VVT: Project Requirements Menu



Selecting *Project Requirements* opens the sub-menu to:

Projects, Entity Inventory, Project Entity Requirements, Project Entity Capability Requirements, DIS Enumeration, Preview Reports and Return to Main Switchboard.

VVT: Projects Listing



Name	Acronym	Synopsis	Begin Date	End Date
NASMP - EA-6B		MM and CGF forces of the EA-6B Weapons System Trainer	3/3/2002	
EA-6B WST				12/4/2002
NASMP - EP-3B		MM and CGF forces of the EP-3B Weapons System Trainer	1/1/2002	
EP-3B				12/31/2002
NASMP - F-18C		MM and CGF forces of the F-18 Weapons System Trainer	2/2/2002	
F-18 SWST				12/4/2002

Record: 1 of 3



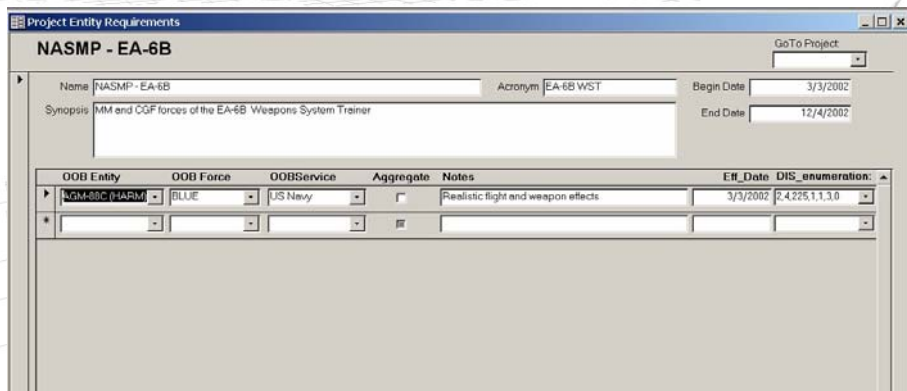
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The **Projects** menu opens a GUI to list each simulation with a brief description and start and ending dates.

Each simulation CGF and cockpits are entered

VVT: Project Entity Requirements



The screenshot shows a software window titled "Project Entity Requirements" with a sub-header "NASMP - EA-6B". It includes a "GoTo Project" dropdown, a "Name" field with "NASMP - EA-6B", an "Acronym" field with "EA-6B WST", a "Begin Date" of "3/3/2002", and an "End Date" of "12/4/2002". A "Synopsis" field contains the text "MM and CGF forces of the EA-6B Weapons System Trainer". Below this is a table with columns: "OOB Entity", "OOB Force", "OOB Service", "Aggregate", "Notes", "Eff. Date", and "DIS enumeration". The first row shows "NASMP - EA-6B" in the OOB Entity column, "BLUE" in OOB Force, "US Navy" in OOB Service, an unchecked "Aggregate" checkbox, "Realistic flight and weapon effects" in Notes, "3/3/2002" in Eff. Date, and "2.4225.1.1.3.0" in DIS enumeration. A second row is partially visible with an asterisk in the OOB Entity column.

OOB Entity	OOB Force	OOB Service	Aggregate	Notes	Eff. Date	DIS enumeration
NASMP - EA-6B	BLUE	US Navy	<input type="checkbox"/>	Realistic flight and weapon effects	3/3/2002	2.4225.1.1.3.0
*			<input type="checkbox"/>			



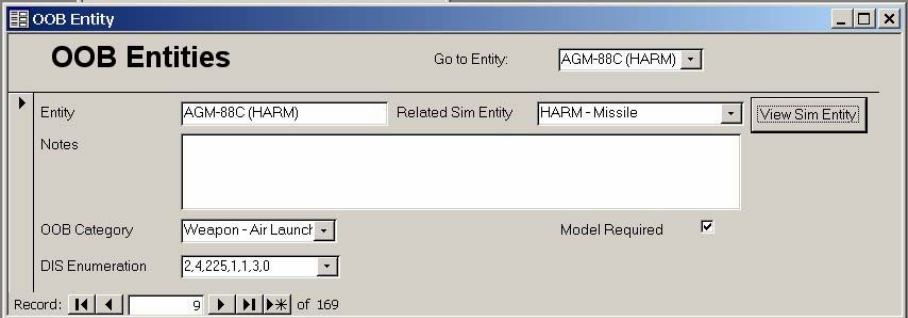
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Hypothetical entry for the EA-6B WST entry of the HARM

Each is added by using the drop down boxes


VVT: Order Of Battle Entities




The screenshot shows a software window titled "OOB Entity" with a "Go to Entity:" dropdown set to "AGM-88C (HARM)". The main form contains the following fields:

- Entity:** AGM-88C (HARM)
- Related Sim Entity:** HARM - Missile (with a "View Sim Entity" button)
- Notes:** A large empty text area.
- OOB Category:** Weapon - Air Launch
- Model Required:** ☒
- DIS Enumeration:** 2.4.225.1.1.3.0

At the bottom, a record navigation bar shows "Record: 9 of 169".

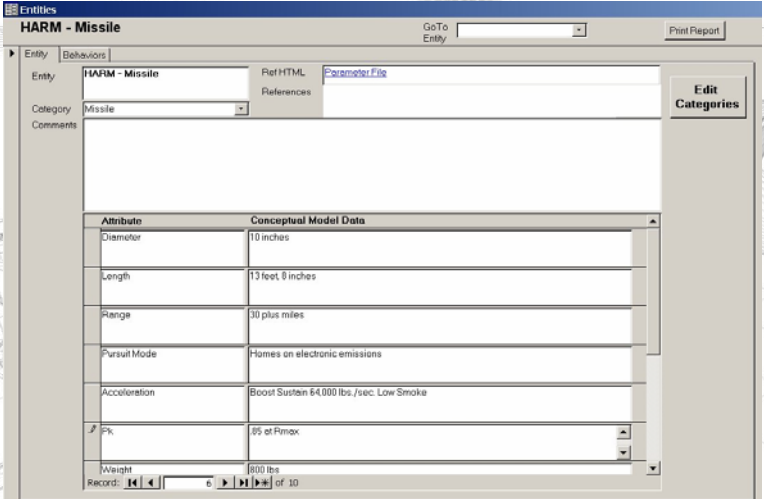
 **NAVMSMO**

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 **BMH**

Each entity is entered (either manual or cut/past from tables or spreadsheets)

VVT: Entity Breakdown



The screenshot shows the 'Entities' window for 'HARM - Missile'. It includes a 'Behaviors' tab, a 'Category' dropdown set to 'Missile', and a table of 'Conceptual Model Data'.

Attribute	Conceptual Model Data
Diameter	10 inches
Length	13 feet 6 inches
Range	30 plus miles
Pursuit Mode	Homes on electronic emissions
Acceleration	Boost Sustain 64,000 lbs./sec. Low Smoke
Pk	95 at Rmax
Weight	800 lbs

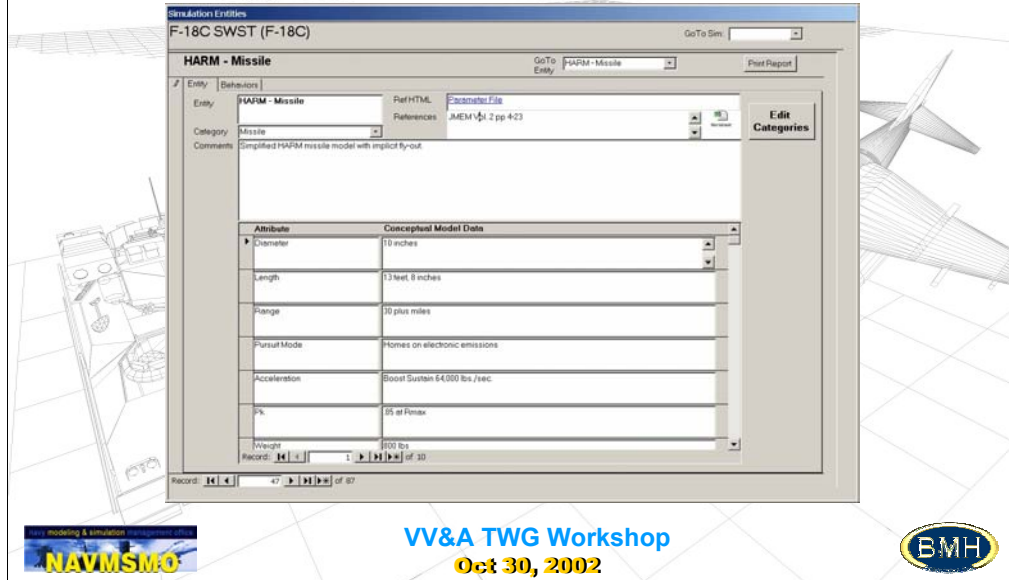
Record: 1 of 10

Logos at the bottom: NAVMSMO, VV&A TWG Workshop Oct 30, 2002, and BMH.

Each model is listed and deconstructed by Physical and behaviors

The VV Toolkit allows for linking to reference HTML data and imbedded documentation of almost any format.

VVT: Entity Breakdown



The difference between the F18 Harm (implicit) and the EA-6B explicit 6DOF

References noted (like JMIMS in this example) and embedded documentation (word, excel, pictures) (the excel spread sheet)

VVT: Project Capability Requirements

Project Entity Capability Requirements
NASMP - EA-6B

Name: NASMP - EA-6B Acronym: EA-6B WST Begin Date: 3/3/2002
Synopsis: MM and CGF forces of the EA-6B Weapons System Trainer End Date: 12/4/2002

GoTo Project

OOB Entity: ACARS HARM OOB Force: BLUE OOB Service: US Navy Aggregate: F Notes: ER Date: 3/3/2002 DIS enumeration: 4.225.1.1.3.9

Project Required Entity Capabilities Subtree

Capability Requirement	Notes	ER Date	View/Edit Cap Req Data	Acceptability Criteria
Weapons employed		View/Edit Capability Req	Acceptability Criteria	
Weapons effects		View/Edit Capability Req	Acceptability Criteria	
Sensors carried		View/Edit Capability Req	Acceptability Criteria	
Sensor employed		View/Edit Capability Req	Acceptability Criteria	
Weapons carried		View/Edit Capability Req	Acceptability Criteria	

Record: 1 of 5
Record: 1 of 1
Record: 1 of 3



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The capabilities required of the EA-6B and HARM

VVT: Selected Entity to OOB

Project Entity Requirements
NASMP - F-18C

Name: NASMP - F-18C Acronym: F-18 WST Begin Date: 2/2/2002
 Synopsis: NM and CGF forces of the F-18 Weapons System Trainer End Date: 12/4/2002

OOB Entity	OOB Force	OOB Service	Aggregate	Notes	ER Date	DRS enumeration
AAV	BLUE	US Navy		Realistic flight and weapon effects		
ACT30H Specie	BLUE	US Air Force		Weapons Package and C2	1.2.205.4.1.2.0	
ADS	BLUE	US Navy		Communication with Mission Support Segment		
ADS Mission Supp	BLUE	US Navy		Communicate with ADS		
ADS Processing	BLUE	US Navy		Communicate with ADS		
Advanced Seal D	BLUE	US Navy		Realistic Maneuvering/GSR performance		
AGF-11	BLUE	US Navy			1.2.205.2.2.1.0	
AGM-114 (HELLFIRE)	BLUE	Joint Multiservice		Realistic flight and weapon effects	2.2.205.1.3.0.0	
AGM-88C (HARM)	BLUE	Joint Multiservice		Realistic flight and weapon effects	2.4.205.1.1.3.0	
AM-10(WZ)	BLUE	US Marine Corps			1.2.205.2.1.1.6.0	
AM-120C	BLUE	Joint Multiservice		Realistic flight and weapon effects	2.1.205.1.2.3.0	
AM-14C	BLUE	Joint Multiservice		Realistic flight and weapon effects	2.1.205.1.8.2.0	
AM-9X	BLUE	Joint Multiservice		Realistic flight and weapon effects	2.1.205.1.1.6.0	
AMS	BLUE	US Navy		GSR		
Ar Delivered Exp	BLUE	US Navy		Realistic flight and weapon effects		
Autonomous Laser Me	BLUE	US Navy		Cueing and Coordination		

Record: 11 of 148

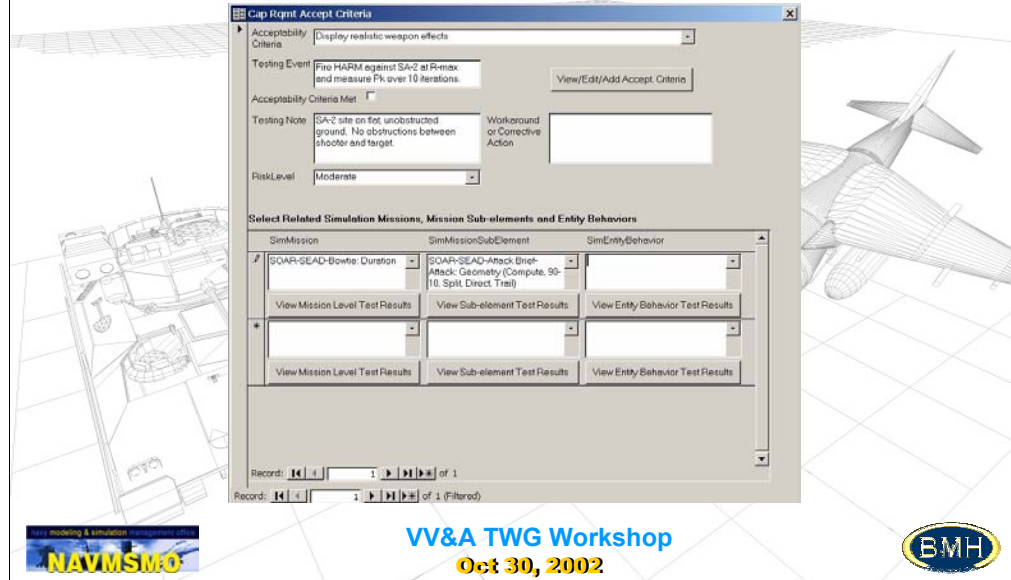


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Shows the entity of interest and a listing of all related models

VVT: Requirements Acceptability Criteria



Acc Criteria listed with associated testing event.

Testing notes and possible work-arounds

Risk Levels

View, Add, and Edit Accept Criteria

V&V Toolkit Reports

SOAR Missions & Behaviors

Mission: SOAR: FAC-A

Forward Air Controller - Airborne; The A/C flies to the designated search grid and fly a 'snake' pattern inside the box until RTB time. The A/C does not report any ground entities.

Mission Level

Item	Test Point	Results
Return	Does the a/c follow the designated route or point(s) to landing	Checks good (BMH Dec 2000)
Controller call sign	Does the a/c take orders from the designated controller (and	Checks good (BMH Dec 2000)
Expected ground threat	Does the a/c understand the ground threat status (AAA or SAMs)	Place holder for further functionality (BMH Dec 2000)
Take off point	Does the a/c instantiate and take off from the designated	Checks good (BMH Dec 2000)
Land Time	Does the a/c land at the designated time	Checks good (BMH Dec 2000)
Land point	Does the a/c land at the designated point	Checks good (BMH Dec 2000)
Transit: Alt/Speed	Does the a/c transit at the designated altitude and airspeed	Checks good (BMH Dec 2000)
Take off time	Does the a/c take off at the designated time	Checks good (BMH Dec 2000)
Mission Tankers	Does the a/c understand its designated tanker	Checks good (BMH Jan 2001)
Rendezvous: Alt/Speed	Does the a/c rendezvous at the	Checks good (BMH Dec 2000)



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Access provides the ability to format reports according to user needs.

The reports can be exported to MS Word (example here) and MS Excel

V&V Toolkit Reports

JSAF Entities

LSD-49 Whidbey Island Class Cargo Variant

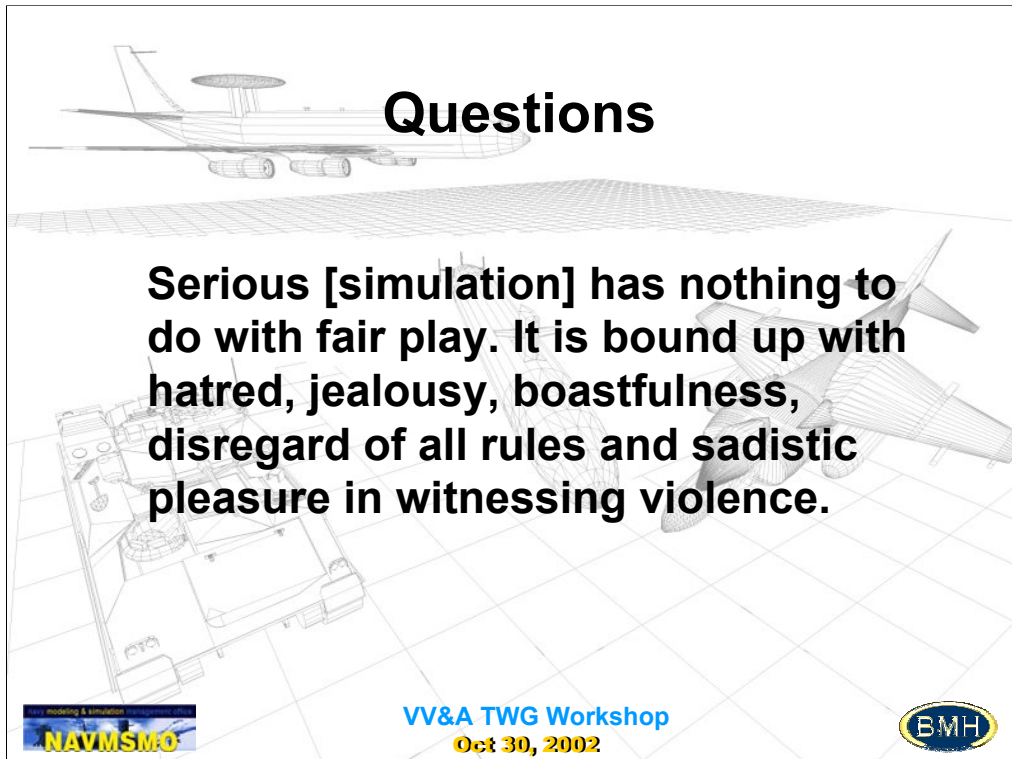
Default number of LCAC attached to Well Deck in SAF exceeds maximum defined in SAF, however maximum appears to be ignored

Attributes	Conceptual Model	JSAF
1. Weapons	1 - CIWS 1 - 25mm Machine Gun	AFT CIWS FWD CIWS
2. Decks	Flight Deck Well Deck	Well Deck LCU AAV LCAC
3. Burn Rate	No conceptual model data available	1306 Liters per Hour @ 14.8 KPH
4. Draft	See Classified Addendum	6.3 m
5. Range	See Classified Addendum	38593.3 km @ 14.816 KPH
6. Max Speed	See Classified Addendum	41 KPH
7. Communications	53 various communications	24 Gen Radios titled "ship_radio0" to "ship_radio23" Ship Gen Report Link11 Protocolink JMCIS
8. Height	No conceptual model data available	45.7 m
9. Sensors	TACAN IFF SPS-67 SPS-49 SPS-64 6 more radars ESM SLQ - 32	TACAN VisualSpotter IFF "SPS67" 185.2 km "SPS49" 474.112 km "SPS64" 118.528 km ESM "SLQ-32"



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With respects to George Orwell